

NEARCTIC DESERT DECTICIDAE (ORTHOPTERA)
PART III THE TRUE TYMPANUM IN CERTAIN
GENERA WITH KEY

Ernest R. Tinkham¹

This is a report on the nature of the true tympanum in Decticidae, its location and taxonomic value. The decticids are a most difficult group to evaluate generically, and any new character that will aid in defining and keying out genera should be of definite taxonomic value in addition to adding to our knowledge on sound reception in these most interesting creatures.

Apparently no recognition has been given in the literature to the location and character of the true tympanum in the Decticidae or related Tettigonoidea or in the Oecanthidae or other orthopteroid families. Textbooks have for many decades illustrated and described the tympanum as located in the basal portion of the protibia where there is a small, hollow, swollen area with internal and external longitudinal slots that are supposed to permit the entrance of sound vibrations. All members of the Tettigonoidea that stridulate are supposed to possess this protibial organ.

Fulton (1928) conducted experiments on certain tettigoniids, including *Neoconocephalus nebrascensis*, *Amblycorypha rotundifolia brachyptera*, and *Oecanthus niveus*, in which half of his caged specimens had their fore tibiae amputated at their bases; the checks were normal. His experiments proved that those with amputated protibiae could still hear but that an asynchronization had developed, while in the control or untreated cages synchronization of stridulation to distant stridulating males proceeded normally. These experiments indicated that tettigoniids and oecanthids with snipped-off fore tibiae could still hear, but the obvious meaning was obscured. Fulton summarized his conclusions thus: "The tympanal organs of the front tibiae are auditory organs, an assumption based on circumstantial evidence of their structure and the fact that they are present in all stridulating species."

It is obvious that such an assumption can be erroneous. It is like amputating the arms but not observing the ears which hear. Certainly, decticids, tettigoniids, oecanthids, and others can still hear sound, even with their front legs cut off, because the tympana are present on the thoraces of these creatures.

Snodgrass (1925) states that "if they [protibial organs] are not ears what are they?"

Such assumptions and conclusions can explain the oversight in recognizing the true tympanum. Obviously, the protibial organ in the decticids, tettigoniids, and oecanthids, as shown by Dr. Fulton's experiments, must be a substation or synchronometer that interprets and passes on the sound received by the true tympanum, herein de-

¹81-441 Date Palm Avenue, Indio, California 92201.

scribed as located on the thorax, and flashes on a response to the tegmina, which stridulate their challenge to the producer of the received sound or song.

That the organ which lies just caudad of the prothoracic spiracle is the tympanum is further corroborated by the position of the tympanum in all those sound-producing acridids in many subfamilies of grasshoppers, where its location is just caudad of the metathoracic spiracle and only two segments removed from that in the Decticinae and just above the metacoxal joint of the hind leg.

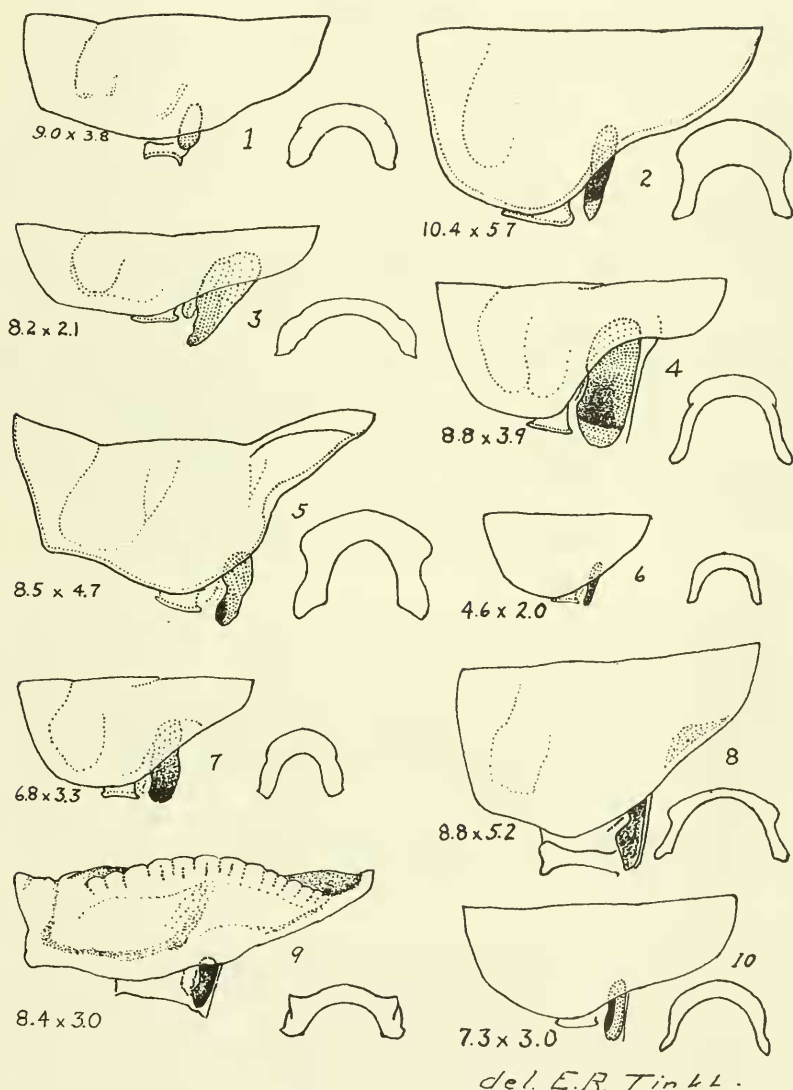
It is interesting to note that the two new genera recently described by the author, namely, *Petropedes* and *Platyoplus*, portray the greatest development of the tympanum, but nature exhibits two different ways to increase the receptivity of sound. In *Platyoplus* (Figure 3) though the pronotum is very broad and very shallow, it still hides half of the very large, auricular-shaped tympanum. To overcome this effect, the pronotum just above the covered upper portion of the tympanum at the posteroventral emargination of the lateral lobes is convexly swollen to facilitate the penetration or reception of sound. On the other hand, in *Petropedes* (Figure 4) although the lateral lobes are very deep, the posteroventral margin is more strongly emarginate or excised than in any other eremicolous dectid genus, so that the huge tympanum is almost completely exposed for the reception of sound.

Although both genera possess a very large tympanum, relationship stops at this point; for the two genera represent two different sections of the Decticinae. *Platyoplus* apparently has its nearest relationships with *Ateloplus*, especially the largest species *A. splendidus*, whereas *Petropedes* seems allied to *Inyodectes* and perhaps *Eremopedes* and *Pediodyctes* as well.

Likewise, it is interesting to note that both recently described genera inhabit barren, inhospitable rocky mountain slopes under a blazing sun, and the enormous tympana would appear to be adaptations to such an environment. *Inyodectes* (Figure 7) seems to bear out this observation, for it also has a relatively large tympanum in relationship to its medium size. Although it does not dwell in such a hot desert as *Petropedes* and *Platyoplus*, which are both members of the fauna of the hottest desert, the Colorado, it does dwell in piles of rocks at the base of talus slopes in the western portions of West-guard Pass at about the lower limits of the pines in the Inyo Mountains, which likewise, because they lie in the rainshadow of the Sierra Nevadas, are very barren and xeric.

In *Ateloplus* (Figure 1), a review of the known species shows that the tympanum is oval in shape and not as large or expanded in its upper half as in *Platyoplus*. In *Ateloplus*, the species *A. schwarzi* and *A. notatus* show tympana that are roundly oval in shape; whereas in *A. hesperus*, *A. luteus*, *A. minor*, and *A. splendidus*, the tympana are more narrowly elliptical in relationship to their size.

In *Eremopedes* (Figures 2, 10), the tympana range from a narrow elliptical slit in *E. shrevei*, *E. balli*, *E. covilleae*, *E. ephippiata*,



Figs. 1-10. Dectidid pronota as seen in lateral aspect and cross-sections from cephalic aspect: 1, *Atelopius splendidus*, male topotype; 2, *Eremopedes ephippiatus sonorensis*, male holotype; 3, *Platyopius gilaensis*, holotype; 4, *Petropedes santarosa*, holotype; 5, *Capnobotes fuliginosus*, male, Mulligan Canyon, Franklin Mts., Texas; 6, *Oreopedes cryptoptera*, female, Westguard Pass; 7, *Inyodectes pallidus*, female topotype, Westguard Pass; 8, *Zacycloptera atripennis*, topotype, Walker Lake, Nevada; 9, *Plagiostira utahensis*, female, western Utah; 10, *Eremopedes bilineatus*, male, Santa Ana, Sonora, Mexico.

and *E. pallidus* to a narrowly oval form in *E. bilineatus*, *E. scudderi*, and *E. ephippiata sonorensis*.

In most of the other genera, such as *Oreopedes* (Figure 6), *Capnobotes* (Figure 5), *Zacycloptera* (Figure 8), *Plagiostira* (Figure 9), *Neduba*, and *Aglaothorax*, the tympana are rather oval elliptical, and some of these, especially *Zacycloptera*, *Plagiostira*, and *Capnobotes*, have the fore margin of the tympanum quite irregular due to the presence of the prothoracic spiracle.

Another feature of the tympanum that should be noted here is whether its periphery is bare or lined with an even row of very fine, short-tapered hairs. In *Platyoplus*, *Petropedes*, *Inyodectes*, *Capnobotes*, and *Anoplodusa*, the peripheral margin is barren of any minute hairs; in *Ateloplus*, the margin is very finely hirsute in the smaller species but bare in *A. splendidus*, the largest species; in *Oreopedes*, the margin is very finely hirsute; in *Eremopedes*, it is barren in some species and hirsute in others. The function of these hairs is not known or surmised at this time; a study of their function and structure would be most interesting and perhaps revealing.

KEY TO CERTAIN EREMICOLOUS GENERA BASED ON TYMPANA AND PRONOTA

1. Tympanum extremely large, located at or near situation of posteroventral margin of lateral lobes of pronotum 2
 Tympana mostly medium to small in size 3
2. Tympanum enormous, broadly oval, and largely exposed by strongly excavate posteroventral emargination of pronotum, although upper quarter still concealed
 *Petropedes*
 Tympanum very large, auricular in outline, largely concealed by very broad, very shallow lateral lobes of pronotum; pronotum convexly swollen above concealed portion of tympanum *Platyoplus*
3. Pronotum barrel-shaped, without lateral carina 7
 Pronotum with partial or complete rounded lateral carinae 4
4. Pronotum extremely large, ovally rounded in dorsal outline, its dorsal surface gently convex 5
 Pronotum not as above, more narrowly linear, sometimes quadrate in dorsal outline; dorsal surface irregular 6
5. Pronotum extremely large, oval in dorsal outline, highly colored *Aglaothorax*
 Pronotum moderately large, colored more drably *Neduba*
6. Size very large; tegmina and wings far surpassing apex of abdomen; metazona with strongly arched lateral ridge or keel *Capnobotes*

- Size large, tegmina and wings slightly longer than pronotum; lateral carina of pronotum crenulate-arcuate; disc of pronotum irregular *Plagiostira*
7. Size very small *Oreopedes*
Size medium to larger 8
8. Body large and heavy; wings jet black; tegmina and wings slightly longer than pronotum *Zacycloptera*
Body much more slender, wings not black; tegmina and wings shorter than pronotum 9
9. Tympanum relatively large for medium size and half exposed *Inyodectes*
Tympanum small, usually oval elliptical; size ranging from small to large 10
10. Size mostly medium to large, mostly heavy bodied; pronotum with deep lateral lobes *Eremopedes*
Size medium large to small; pronotum broad, with disc convex and with rather shallow lateral lobes *Ateloplus*

REFERENCES

FULTON, B. B. 1928. A demonstration of the location of auditory organs in certain Orthoptera. *Ann. Ent. Soc. Amer.* 31:445-448.

SNODGRASS, R. E. 1925. Insect musicians, their music and their instruments. *Ann. Rpt. Smithsonian Inst.* 1923:405-452.

TINKHAM, E. R. 1972. Nearctic desert Decticidae (Orthoptera). Part I. A new genus from California. *Great Basin Nat.* 32:176-179.

———. 1973. Nearctic desert Decticidae (Orthoptera). Part II. A new genus and species from Arizona. *Great Basin Nat.* 33:43-50.

NOTES ON REPRODUCTION IN *LAMPROPELTIS TRIANGULUM* AND *COLUBER CONSTRICTOR* IN UTAH

William L. Grogan¹ and Lloyd C. Pack, Jr.²

A search of the literature has revealed no published records of egg laying in *Lampropeltis triangulum taylori* Tanner and Loomis. On 8 July 1967 a female with a snout-vent length of 494 mm was collected in Hobble Creek Canyon, 7 mi. east of Springville, Utah. On 20 July four eggs were laid. After four weeks of incubation the eggs were attacked by fungi and were discarded.

Van de Velde, Martan, and Risley (1962) first described the hatching of eggs of *Coluber constrictor mormon* Baird and Girard. Since then no other hatchings have been recorded. On 12 July 1967 one male and three gravid females were collected at the same locality as above. Clutches of seven eggs were laid on 21 July, six on 24 July, and six on 28 July. The eggs were placed on moist sand in a jar for incubation. The last laid clutch was discarded because of fungi. Two eggs of that clutch were dissected and found to contain embryos. Two eggs of the first clutch hatched on 26 September and five on 27 September. Three eggs of the second clutch hatched on 1 October and one on 3 October. The remaining two eggs in this clutch did not hatch. The time of hatching varied from 67 to 70 days, with eight of the eleven hatching in 68 days.

The color pattern of our specimens was similar to that described by Van de Velde, Martan, and Risley (1962); however, there were a few important differences. The dorsal saddles ranged from 46 to 51 as compared with their 69. The chin, throat, infralabials, and supralabials are a vivid white with dark reddish brown spots on the posterior margins of the supralabials and the last infralabial. The color of the head also differs in that the ground color is light gray brown with darker brown spots on the prefrontals, supraoculars, frontal and parietals.

Four of the hatchlings are preserved in collections of Brigham Young University (BYU 30808-30811). Their respective snout-vent and total lengths in mm are: 192-263, 222-284, 202-280, 201-274.

We are indebted to Wilmer W. Tanner and Donald M. Allred for criticism of the manuscript.

LITERATURE CITED

- VAN DE VELDE, R. L., J. MARTAN, AND P. L. RISLEY. 1962. Eggs and hatchlings of the snake *Coluber constrictor mormon* from Oregon. *Copeia* 1962(1), 212-13.

¹Department of Zoology, Brigham Young University, now at Department of Entomology, University of Maryland, College Park, Maryland 20742.

²Department of Zoology, Brigham Young University, Provo, Utah 84602.

COURTSHIP BEHAVIOR AMONG WHITE-TAILED AND BLACK-TAILED JACKRABBITS

Del F. Blackburn¹

This paper represents a portion of a research project on behavior of black-tailed and white-tailed jackrabbits, *Lepus californicus* and *L. townsendii*, of the Castle Rock area of Eastern Oregon. The full study is described elsewhere (Blackburn, 1968).

The observations made of jackrabbit courtship behavior from April through July, 1967-68 were quite similar to those described by Severaid (1941), Janson (1946), Lechleitner (1959), Haskell and Reynolds (1947), and Pentrelli (1968).

I observed both white-tailed and black-tailed jackrabbits in varying habitat and behavioral situations. This provided the opportunity to extend many of the reports just mentioned.

Both Pentrelli and Lechleitner reported black-tailed jackrabbits as having very intense courtship behavior involving circling, male and female approaches, and long chases. In this study urine emission was observed during the jumping and chasing activity. This complex behavior involving combinations of all the above listed components was observed to last from 5 to 20 minutes. Copulation usually followed. After copulation the male jackrabbit was observed on several occasions to jump slightly backwards, fall to the ground, emit a hissing squeal and leap up again renewing the chase with subsequent copulations of up to four times.

Although only a few observations of courtship among white-tailed jackrabbits were possible in this study, their courtship behavior was observed to be basically the same as that of black-tailed jackrabbits, with the exception that jumping behavior was more pronounced.

Tinbergen (1952) states that displacement behavior is caused or motivated by a surplus of stimulus or drive. A jackrabbit, highly excited during escape or reproductive behavior, may exhibit this type of activity. I observed five male black-tailed jackrabbits in pursuit of one female. After sighting me, two of the males left the pack and began feeding. They fed vigorously and did not attempt to leave the area upon my approach. Shortly afterwards, two other males abandoned the female and began attempting to copulate with each other. Upon collection, both had their penises fully extended. Both of these behavior types suggest a displacement type of behavior. A single remaining male was observed to copulate twice with the female. The entire area surrounding this field of activity was covered with hair, the presence of which suggested fighting.

I thank the Bureau of Land Management, Vale, Oregon, for their support of this study. It was conducted under the guidance of the Department of Zoology, University of Idaho, Moscow, Idaho.

¹Biology Department, Clark College, Vancouver, Washington.

LITERATURE CITED

- BLACKBURN, D. F. 1968. Unpublished M.S. Thesis, University of Idaho, Moscow, Idaho.
- HASKELL, H. S., AND REYNOLDS, H. G. 1947. Growth, developmental food requirements, and breeding activity of California jackrabbits. *Journ. Mammal.* 28:129-136.
- JANSON, R. G. 1946. Survey of the native rabbits of Utah, with reference to their classification, distribution, their history, and ecology. M.S. Thesis, Utah State University.
- LECHLEITNER, R. R. 1959. Sex ratio, age classes and reproduction of the black-tailed jackrabbit. *Journ. Mammal.* 40:63-81.
- PENTRELLI, M. J. 1968. Mating behavior of the black-tailed jackrabbits. *Journ. Mammal.* 49:785-786.
- SEVERAID, J. H. 1941. The life history and artificial propagation of the snowshoe hare, *Lepus americanus strutherus bangs*. M.S. Thesis, University of Maine.
- TINBERGEN, N. 1952. Derived activities; their causation, biological significance, origin and emancipation during evolution. *Quart. Rev. Biol.* 27:1-32.